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# Rocket report

Sounding Rockets Program Office



## In Brief...

The Sounding Rockets Working Group (SRWG) met at Greenbelt June 11 – 12, 2013. For more information about the working group, visit: <http://rscience.gsfc.nasa.gov/index.html>

A Terrier–Orion rocket display was installed at the Baltimore Washington International airport (BWI).

Wallops Safety Day was held on June 26th, all NASA organizations and contractors attended presentations and panel discussions about pertinent safety issues. Safety is everones responsibility!

Design and status meetings have been held with the Peregrine test flight payload teams.

The Kwajalein campaign was completed with all four rockets successfully flown.

Nine sounding rockets with missions ranging from Solar Physics to Education were launched in the 2nd quarter of 2013.

Sub-orbital Local Interstellar Cloud Experiment (SLICE) - 36.271 UG France

The Sub-orbital Local Interstellar Cloud Experiment (SLICE) used an 8-inch diameter telescope and spectrograph covering the far-ultraviolet wavelength range from 102 – 107 nm, to study the interstellar medium.

Kevin France, the SLICE principal investigator from Colorado, said “We hope to observe four hot stars in the constellations of Orion and Taurus. We use these stars as background sources to study the composition, temperature, and ionization state of material in the interstellar medium.”

“This particular ultraviolet spectral window can only be accessed from space. These spectra will enable us to measure several phases of the interstellar medium: from the cool molecular gas that will eventually form the next generation of stars, to the hot gas that is driven into the interstellar medium when massive stars die in supernova explosions,” he said.

So, why the interest in this space in space? The immediate interstellar environment determines the structure of the heliosphere. The heliosphere controls the cosmic ray flux seen in the inner solar system which has a profound effect on the Earth, influencing cloud cover, lightning frequency, upper atmosphere chemistry and even mutation rates of surface, deep-earth and deep-sea organisms.

The interaction of stellar winds and the interstellar medium is a general phenomenon, and thus all stars and planetary systems will have the astrospheric interfaces. Understanding the structure of the local interstellar medium is important in evaluating the cosmic ray environment and the potential habitability of nearby exoplanets.



SLICE telescope and spectrograph during integration and testing at Wallops.

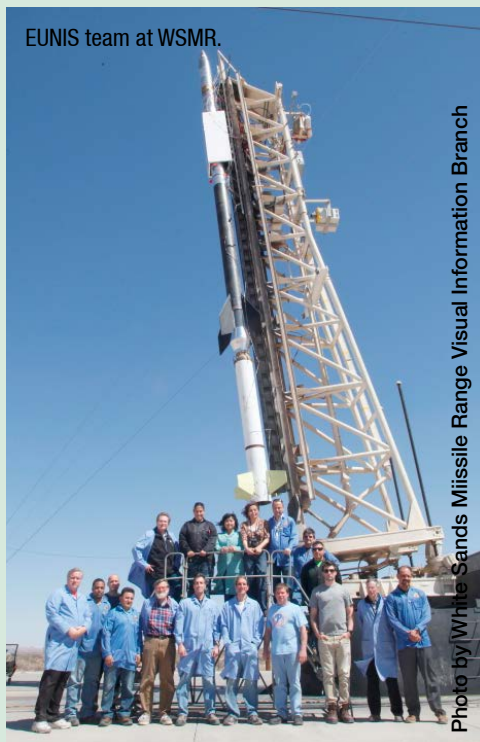
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## Extreme Ultraviolet Normal Incidence Spectrograph (EUNIS) - 36.269 GS Rabin

The EUNIS mission gathered data on the way material of different temperatures flows through the sun's corona. An exposure every 1.2 seconds, enables observation of minute details of how dynamic events on the Sun happen over times of two to three minutes." Watching the sun at this kind of time cadence helps scientists understand the complex movements of solar material – a heated, charged gas known as plasma – as it heats and cools, rising, sinking and gliding around with every change in temperature. Adding to the complexity of the flows are magnetic fields traveling along with the plasma that also guide the material's movements.

The research is geared toward addressing key outstanding questions in solar physics including how the sun's outer atmosphere, or corona, is heated, what drives the solar wind, and how energy is stored and released to cause eruptions.

Excerpt from [http://www.nasa.gov/mission\\_pages/sounding-rockets/news/eunis.html](http://www.nasa.gov/mission_pages/sounding-rockets/news/eunis.html), by Karen Fox.



EUNIS team at WSMR.

Photo by White Sands Missile Range Visual Information Branch

## Kwajalein Campaign - Equatorial Vortex Experiment (EVEX) and Metal Oxide Space Cloud experiment (MOSC)

The EVEX mission launched two rockets, a Terrier-Improved Malemute and a Terrier-Oriole, from the Kwajalein Atoll in the Marshall Islands. EVEX will help scientists better understand and predict the electrical storms in the ionosphere.

The two rockets measured events in two separate regions of the ionosphere to see how they work together to drive the ionosphere from placid and smooth to violently disturbed. Such information could ultimately lead to the ability to accurately forecast this important aspect of space weather. "We're looking at the two highest regions of the equatorial ionosphere, called the E- and F- regions," says Erhan Kudeki, the principal investigator for the mission at the University of Illinois in Urbana-Champaign. "Violent ionospheric storms can occur in the equatorial F-region a few hours after sunset and if we can better understand what causes these storms, we'll be able to better mitigate their effects on communication and navigation systems."

The research goal is to study whether turbulence at sunset in the E-region of the ionosphere could serve as a warning of storms in the higher F-region an hour or two later, so the team plans to launch on an evening when ground based radar shows the necessary turbulence in the E-region. An important element of these experiments involved measurements of the atmospheric winds at high altitudes.

Just as on the ground, winds at very high altitudes carry a tremendous amount of energy and are known to have a direct effect on the ionospheric disruptions that are the focus of EVEX. Wind measurements at these altitudes are difficult because of the very low atmospheric density. Over the past five decades, several tracer techniques have been perfected to accomplish this by optical tracking of visible gases released from the rockets. Lithium vapor and trimethyl aluminum (TMA) gas have been particularly effective.

Both rockets were successfully launched on May 7, 2013. The Terrier-Oriole was first off the pad, flying to an altitude of approx. 330 km, followed by the Terrier-Improved Malemute reaching an altitude of 183 km.

With two sounding rockets, a multitude of ground radar sites, and instruments to measure a suite of information about both charged and neutral particles, scientists using EVEX data will be able to study the equatorial ionosphere as a system -- understanding how one characteristic effects another – in a way that has never been done before.

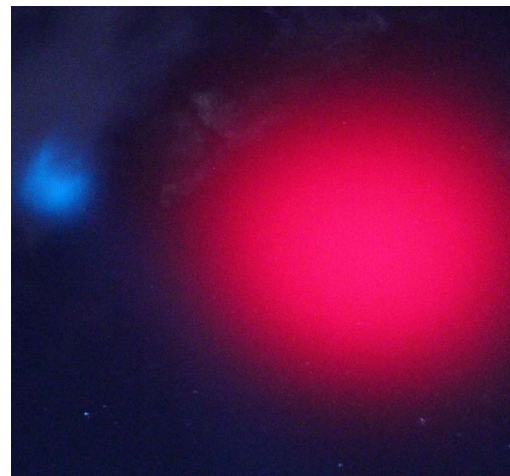
The two MOSC launches, both Terrier-Improved Orions, occurred on May 1st and May 8th respectively. Successful samarium vapor releases created red clouds of charged particles in the ionosphere. Researchers from the Air Force Research Laboratory studied the cloud as it dispersed and its impact on radio transmissions sent from multiple locations. MOSC was launched with the assistance of the Department of Defense Space Test Program.

Excerpt from [http://www.nasa.gov/mission\\_pages/sounding-rockets/news/evex.html](http://www.nasa.gov/mission_pages/sounding-rockets/news/evex.html) by Karen Fox



Sounding rocket launches from Roi-Namur.

Photo by John Grant/Wallops Imaging Lab



TMA and Lithium releases.

Photo by John Grant/Wallops Imaging Lab



## Far-ultraviolet Off Rowland-circle Telescope for Imaging and Spectroscopy (FORTIS) - 36.268 McCandliss

FORTIS was successfully launched from White Sands Missile Range, NM on May 10, 2013. The goal of FORTIS is to explore the mysteries of escaping of ultraviolet radiation from the dusty confines of galaxies, using a new type of spectro/telescope with more than six times the sensitivity of our previous experiments. FORTIS can acquire spectra from forty-three individual targets simultaneously, and autonomously, within an angular region as large as the diameter of the moon (1/2 degree).

More information on FORTIS is available at:  
<http://hub.jhu.edu/gazette/2012/october/building-a-rocket-from-scratch>  
<http://krieger.jhu.edu/magazine/v10n1/it-really-is-rocket-science/>

## Cosmic Infrared Background Experiment (CIBER) - 40.030 Bock

CIBER was successfully launch from Wallops Island, VA on June 5, 2013. This was the fourth, and final, flight of the instrument. The previous CIBER missions in 2009, 2010 and 2012, were launched from White Sands Missile Range, NM.

Scientists use data collected with CIBER to seek to answer question such as when did the first stars and galaxies form in the universe and how brightly did they burn their nuclear fuel? The objectives of the experiment are of fundamental importance for astrophysics, to probe the process of first galaxy formation, but the measurement is also extremely difficult technically.

Jamie Bock, CIBER principal investigator from the California Institute of Technology, said, "The first massive stars to form in the universe produced copious ultraviolet light that ionized gas from neutral hydrogen. CIBER observes in the near infrared, as the expansion of the universe stretched the original short ultraviolet wavelengths to long near-infrared wavelengths today. CIBER investigates two telltale signatures of first star formation -- the total brightness of the sky after subtracting all foregrounds, and a distinctive pattern of spatial variations."

CIBER previously flew on two-stage Black Brant IX sounding rockets. Bock said, "The collection of data from the three flights allows us to compare data and rigorously test sources of potential systematic error from both the instrument and astrophysical foregrounds. We have been through the end-to-end process in analyzing our data, so we understand the benefits of going with a non-recovered Black Brant XII. We also know the performance of the instrument very well from these flights and that makes us confident going forward with this investigation."

"Our experience in the near-infrared waveband is that we see appreciable emission from the atmosphere up to 250 km. The higher trajectory allows us to do some new things that are not possible on a Black Brant IX. For example, we expect to have enough independent images of the sky to directly determine the in-flight gain of the infrared cameras, which will allow us to measure background fluctuations in single exposures. This gives us a much more direct way to compare with satellite data than the statistical combinations we have had to use to date. The higher trajectory of course comes with a price in that the payload is not recovered," he said.

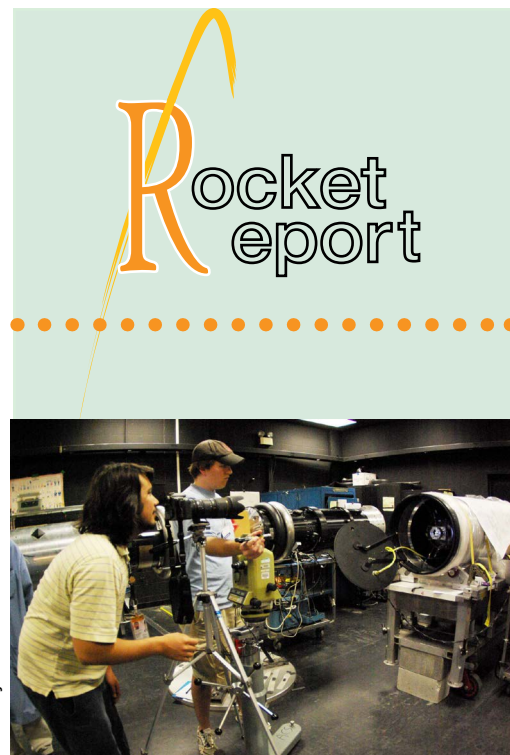
CIBER is a cooperative instrument designed and built by the California Institute of Technology, University of California Irvine, the Japan Aerospace Exploration Agency (JAXA), and the Korean Astronomy and Space Science Institute (KASI). The same team is also developing an improved follow-on experiment, with more capable optics and detector arrays, that will be completed next year.

Originally published at [http://www.nasa.gov/mission\\_pages/sounding-rockets/missions/CIBER-4.html](http://www.nasa.gov/mission_pages/sounding-rockets/missions/CIBER-4.html) by Keith Koehler.



Photos by Berit Bland

FORTIS on the spin balance table in the Testing and Evaluation lab.



FORTIS being prepared for sensor alignments in the Attitude Control Systems Lab.



CIBER sensor checkout in the cleanroom in building F-7 at Wallops Flight Facility.



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Launch photo by Chris Perry/Wallops Imaging Lab

## RockOn! - 41.106 UO Koehler

41.106 UO Terrier-Improved Orion was launched from Wallops Island, VA on June 20, 2013. The RockOn workshop is intended to be an introductory flight opportunity to provide exposure to, and spark interest in, space based science missions. This will be accomplished by flying two classes of experiments. First time participants will generally fly the simpler kit built experiment. As educational institutions gain more experience, it is expected they will progress towards developing their own unique RockSat-C class experiments. The Principal Investigator is Mr. Chris Koehler/Colorado Space Grant Consortium.

Activities during the week will include a RockOn! workshop for 50 university and community college-level participants. "Rocket Week brings together students and teachers from across the country to experience first-hand the exciting world of rocketry," said Joyce Winterton, senior advisor for education and leadership development at Wallops. "For students, it provides them valuable experience to blend with academics for their future STEM (science, technology, engineering and mathematics) careers. The educators gain valuable experience to expand their curriculum in the classroom and mentor students for STEM majors and careers."

RockOn! Introduces participants to building small experiments that can be launched on suborbital sounding rockets. Now in its sixth year, the workshop is conducted in partnership with the Colorado and Virginia Space Grant Consortia.

"Working with NASA, we have developed a step approach to expand the skills needed for students to enter STEM careers," said Chris Koehler, director of the Colorado Space Grant Consortium. "RockOn! is the first step, followed by RockSat-C and then RockSat-X. Each step is technically more challenging than the previous one, allowing the students to expand the skills needed to support the aerospace industry."

Nine custom-built Rocksat-C experiments, developed at universities that previously participated in a RockOn! Workshop, also flew inside a payload canister on the rocket.

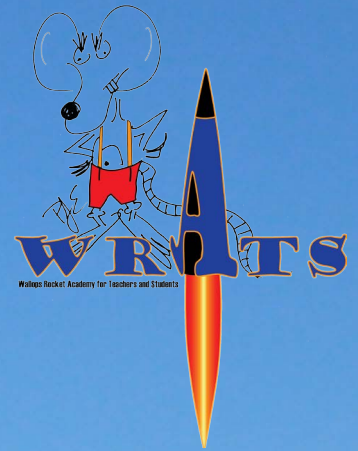
For more information about RockOn!, RockSat-C and RockSat-X, visit:

<http://spacegrant.colorado.edu/national-programs/rockon-2013-home/>

Originally published at: [http://www.nasa.gov/centers/wallops/news/HQ\\_13-186\\_Rocket\\_Week\\_WFF.html](http://www.nasa.gov/centers/wallops/news/HQ_13-186_Rocket_Week_WFF.html)



For the third year the Sounding Rockets Program Office arranged the Wallops Rocket Academy for Teachers and Students (WRATS) workshop for High School educators. 20 high school teachers from Virginia, Maryland, Delaware, Pennsylvania, Tennessee and the District of Columbia learned about the dynamics of rocketry and the science gained from suborbital sounding rockets to reinforce STEM concepts they teach in their classrooms.



Starting with an overview of sounding rockets, the teachers learned about science applications, launch vehicles, operations and gained insight into payload testing procedures through a tour of the Testing and Evaluation lab. Model rocket construction activities were also accomplished on the first day of the workshop and each participant built an E-engine powered model rocket. Activities continued with the construction of an Arduino Uno based payload which incorporates three sensors; an accelerometer, a pressure transducer and a thermistor. The payloads were fitted into the model rocket and were flown later in the week to collect data during the flight.

Several interactive lectures with physics demonstrations were conducted by Phil Eberspecker/Chief Sounding Rockets Program Office. The demonstrations enhance the understanding of rocket physics and provide participants with theoretical physics and math applications, as well as, hands-on activities to conduct with their students.

Recovery system (parachute) design, construction and testing familiarized the educators with the geometry of parachute shapes, size estimation and drag calculations. All parachutes were drop tested prior to flight. The rockets were tested for stability and the pitch moment of inertia was measured using a bifilar pendulum method. Additional activities during the week included a model rocket motor test firing, tours of Wallops Flight Facility and the launch of RockOn! a once in a life-time experience for many of the teachers.

The model rockets were successfully flown and recovered on the Wallops airfield and the educators left Wallops with a rocket, a payload and new insight into aerospace and rocketry.





## Integration and Testing

### 21.140 & 41.090 Pfaff – Daytime Dynamo

The Daytime Dynamo Rocket Investigation is a rocket payload pair to investigate the Neutral-Ion Coupling and Shear Wind Effects in the Daytime Lower Ionosphere. This investigation will explore, for the first time, the ion-neutral coupling, wind shears, and electrodynamics of the mid latitude lower ionosphere during the daytime. In particular, it will determine the cause of intense daytime irregularities that are consistently observed in the mid-latitude, ionosphere during the summer.

The investigation will examine, as a function of altitude, the relationship of the electric fields, currents, neutral winds, plasma density, ion mass, and neutral density in order to reveal fundamental processes regarding the momentum transfer between the ionized and neutral gases and their associated electrodynamics (e.g. the daytime dynamo). The data will be used to determine the relative roles of DC electric fields, plasma density gradients, and wind shears as the source of the intense irregularities.

The rocket/payload pair includes a highly instrumented payload with multiple sensors on booms and appendages. The second payload of the pair includes a lithium pyrophoric ejection along with a falling sphere incorporating GPS for tracking purposes.

For more information, see [http://www.nasa.gov/mission\\_pages/sounding-rockets/news/electrical-dynamo.html](http://www.nasa.gov/mission_pages/sounding-rockets/news/electrical-dynamo.html)



Max Fowle and Wayne Taylor preparing for a boom deployment test.



Robby Rennolet with the falling sphere experiment.



Charlie Cathell, Tommy Russell, Max Fowle and Andrew Mandigo with the instrumented payload.



# Rocket report

Mr. Whippy visits





## Want to contribute?

Working on something interesting, or have an idea for a story? Please let us know, we'd love to put it in print!

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## Launch Schedule

### July

21.140 GE	PFAFF/NASA-GSFC	WI
41.090 GE	PFAFF/NASA-GSFC	WI
46.006 GT	ROSANOVA/NASA/GSFC-WFF	WI
36.239 DS	KORENDYKE/NRL	WS

### August

46.005 UO	KOEHLER/UNIV. OF COLORADO	WI
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### October

36.281 UE	BOCK/CAL TECH	WS
36.253 US	HASSLER/SWRI	WS
36.290 UE	WOODS/UNIV. OF COLORADO	WS

### November

36.261 UG	CLARKE/BOSTON UNIVERSITY	WS
36.288 DS	VOURLIDAS/NRL	WS

WS – White Sands  
WI – Wallops Island

## Vehicle Assembly Building (VAB) Ribbon Cutting Ceremony

Dr. Stephan McCandliss cut the ribbon inaugurating the upgraded VAB at White Sands Missile Range.

The multi-year upgrade to the facilities started in 2011 with a new clean integration facility and ended in 2012 with the addition of new offices and a Telemetry ground station.



Photo by White Sands Missile Range Visual Information Branch